

## VERIFICATION OF TRANSLATION

Re : Japanese Patent Application No. 2002-377390

I, Miki HARIMA, of c/o Hosoda International Patent Office, OMM Building 5th Floor, P.O. Box 26, 1-7-31 Otemae, Chuo-ku, Osaka 540-6591, JAPAN, hereby declare that I am the translator of the documents attached and certify that the following is a true translation of the best of my knowledge and belief.

Dated this 18th day of October, 2005

A handwritten signature in cursive script, appearing to read "Miki Harima", written in dark ink.

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JAPAN PATENT OFFICE

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[List of Annexed Documents]

[Document]	Specification	1
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[Document] Specification

[Title of the Invention] Polishing Composition

[Claims]

[Claim 1] A polishing composition for a memory hard disk comprising an abrasive in an aqueous medium, wherein the abrasive comprises silica particles having particle sizes of from 5 to 120 nm in an amount of 50% by volume or more, wherein the abrasive comprises 10 to 70% by volume of small size silica particles having particle sizes of 5 nm or more and less than 40 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of intermediate size silica particles having particle sizes of 40 nm or more and less than 80 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 40% by volume of large size silica particles having particle sizes of 80 nm to 120 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm.

[Claim 2] The polishing composition according to claim 1, wherein the abrasive comprises 5 to 70% by volume of particles having particle sizes of from 10 to 30 nm in the small size silica particles based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of particles having particle sizes of from 45 to 75 nm in the intermediate size silica particles based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 25% by volume of particles having particle sizes of from 90 to 110 nm in the large size silica particles based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm.

[Claim 3] The polishing composition according to claim 1 or 2,

wherein the silica is colloidal silica.

[Claim 4]        A method of reducing micropits with the polishing composition as defined in any one of claims 1 to 3.

[Claim 5]        A method for manufacturing an Ni-P plated substrate for memory hard disk with the polishing composition as defined in any one of claims 1 to 3.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Pertains]

The present invention relates to a polishing composition, a method of reducing micropits with the polishing composition, and a method for manufacturing a substrate with the above-mentioned polishing composition.

[0002]

[Prior Art]

In recent memory hard disk drives, high storage capacity and miniaturization have been demanded. In order to increase the recording density, it has been strongly urged to lower flying height of a magnetic head and to reduce the unit recording area. Along with this trend, the surface quality required after polishing has become severely assessed every year even in a process for manufacturing a substrate for magnetic disk. To comply with low flying height of the head, the surface roughness, microwaviness, roll-off and projection are reduced and, to comply with reducing the unit recording area, the sizes and depths of scratches and pits are smaller and smaller.

[0003]

In order to meet such requirements, there has been known a polishing

composition for an aluminum disk substrate, with which an aluminum disk substrate having small average waviness and a few surface defects can be obtained, and in which colloidal silica particles having different mono-modal number particle size distributions are contained (see, for instance, Patent Publication 1).

[0004]

In addition, there has been known a polishing composition containing colloidal silicas having a specified particle size distribution, which has excellent surface smoothness, whereby polishing can be carried out at an economical rate without generating surface defects (see, for instance, Patent Publication 2).

[0005]

However, in the polishing composition, there has not been any contrivances in a case where alumina abrasive grains are used for primary polishing, from the viewpoint of preventing defects of pits which are caused by the alumina abrasive grains remaining on the substrate surface (hereinafter referred to "micropits"). Therefore, further improvements have been desired.

[0006]

Here, the "micropits" refers to a surface defect which differs from usual pits in that the defect cannot be clearly detected as a bright spot with a differential interference optical microscope, so that this defect has not conventionally been satisfactorily studied. Therefore, the micropits have been recently rapidly recognized as surface defects for substrates which hinder the miniaturization of the unit recording area.

[0007]

[Patent Publication 1]

Japanese Patent Laid-Open No. 2002-30274 (claim 1)

[Patent Publication 2]

Japanese Patent Laid-Open No. 2001-323254 (claim 1)

[0008]

[Problems to Be Solved by the Invention]

An object of the present invention is to provide a polishing composition for polishing a substrate for memory hard disk, with which micropits of the object to be polished after polishing are remarkably reduced and the polishing can be carried out economically advantageously, a method of reducing micropits with the polishing composition, and a method for manufacturing a substrate with the above-mentioned polishing composition.

[0009]

[Means to Solve the Problems]

Specifically, the gist of the present invention relates to:

[1] a polishing composition for memory hard disk containing an abrasive in an aqueous medium, wherein the abrasive contains silica particles having particle sizes of from 5 to 120 nm in an amount of 50% by volume or more, wherein the abrasive contains 10 to 70% by volume of small size silica particles having particle sizes of 5 nm or more and less than 40 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of intermediate size silica particles having particle sizes of 40 nm or more and less than 80 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 40% by volume of large size silica particles having particle sizes of 80 nm to 120 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm;

[2] a method of reducing micropits with the polishing composition of the above [1]; and

[3] a method for manufacturing an Ni-P plated substrate for memory hard disk with the polishing composition of the above [1].

[0010]

[Modes for Carrying out the Invention]

The polishing composition of the present invention is a polishing composition for memory hard disk containing an abrasive in an aqueous medium, wherein the content of silica particles having particle sizes of from 5 to 120 nm is 50% or more, on a volume basis, of the entire amount of the abrasive, wherein the abrasive contains 10 to 70% by volume of small size silica particles having particle sizes of 5 nm or more and less than 40 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of intermediate size silica particles having particle sizes of 40 nm or more and less than 80 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 40% by volume of large size silica particles having particle sizes of 80 nm to 120 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm.

[0011]

In the present invention, since the abrasive containing the silica particles having specified particle size distribution as mentioned above is used in an amount equal to or greater than the specified amount, there are exhibited effects for polishing a memory hard disk that the micropits of the object to be polished after polishing are remarkably reduced and that the polishing can be carried out economically advantageously.

[0012]

Here, the “micropits” refers to (1) a pit which can be observed only in a state where the surface of a substrate is sufficiently planarized, when observed with a differential interference optical microscope at a magnification of from 50 to 100 times; or (2) a pit which can be observed as an inverted cone shape having a diameter of from 0.2 to 5  $\mu\text{m}$  and a depth of from 10 to 100 nm, when observed with an atomic force microscope, wherein (3) Al element is detected at the bottom of the pit. The detection of Al elements can be confirmed by combining a scanning electron microscope (SEM) and elementary analysis technique (EDS and Auger electron spectroscopy).

[0013]

It is thought that the micropits are generated for the following reasons. As the average particle size of the abrasive becomes smaller, the mechanical polishing power becomes deficient, so that the residuals such as stuck alumina abrasive grains in a previous process are less likely to be discharged, whereby those discharged in the later stage of the polishing process are not polished and remain as pits.

[0014]

The abrasive used in the present invention contains 50% by volume or more of the silica particles having particle sizes of from 5 to 120 nm. The content of the above-mentioned silica particles having particle sizes of from 5 to 120 nm is preferably 55% by volume or more, preferably 60% by volume or more, from the viewpoint of reducing the micropits, the surface roughness and the scratches.

[0015]

The silica includes colloidal silica, fumed silica, the surface-modified silica, and the like. Among them, the colloidal silica is preferable, from the viewpoint of being suitable for final finish polishing for a substrate for a high-recording density memory magnetic disk requiring a higher smoothness. The colloidal silica particles can be obtained by a process, for instance, including the step of generating the colloidal silica particles from an aqueous sodium silicate.

[0016]

The above-mentioned abrasive contains 10 to 70% by volume of small size silica particles having particle sizes of 5 nm or more and less than 40 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of intermediate size silica particles having particle sizes of 40 nm or more and less than 80 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 40% by volume of large size silica particles having particle sizes of 80 nm to 120 nm based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm.

[0017]

The content of the above-mentioned small size particles is preferably from 12 to 68% by volume, more preferably from 15 to 65% by volume, even more preferably from 20 to 60% by volume, most preferably from 30 to 60% by volume, from the viewpoint of reducing the micropits. The content of the intermediate size particles is preferably from 25 to 70% by volume, more preferably from 25 to 60% by volume, even more preferably from 30 to 50% by volume, from the viewpoint of reducing the micropits. The content of the large

size particles is preferably from 0.5 to 35% by volume, more preferably from 1 to 30% by volume, from the viewpoint of reducing the micropits.

[0018]

In particular, it is desired that the abrasive used in the present invention contains 5 to 70 % by volume, preferably from 10 to 50 % by volume, of particles having particle sizes of from 10 to 30 nm in the small size silica particles based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume, preferably from 22 to 65 % by volume, of particles having particle sizes of from 45 to 75 nm in the intermediate size silica particles based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 25% by volume, preferably from 1 to 15% by volume, of particles having particle sizes of from 90 to 110 nm in the large size silica particles based on the entire amount of the silica particles having particle sizes of from 5 to 120 nm, from the viewpoint of reducing the micropits.

[0019]

The particle size distribution of the above-mentioned silica particles can be determined by the method described below. Specifically, the photographs of the colloidal silica observed by a transmission electron microscope "JEM-2000 FX" commercially available from JEOL LTD. (80 kV, magnification: 10000 to 50000) were incorporated into a personal computer with a scanner connected thereto. The equivalent diameter of each silica particle was determined using an analysis software "WinROOF" (commercially available from MITANI CORPORATION), and considered as the diameter of the silica particles. After analyzing data for 1000 or more silica particles, the volume of the silica particles was calculated from the diameters of the silica particles based on the analyzed

data using a spreadsheet software “EXCEL” (commercially available from Microsoft Corporation). First, the ratio (% based volume) of the particles having particles sizes of equal to or greater than 5 nm and equal to or less than 120 nm (5 to 120 nm) was calculated, and the ratios (% based volume) of three regions, namely a region of equal to or greater than 5 nm and less than 40 nm (5 nm or more and less than 40 nm); a region of equal to or greater than 40 nm and less than 80 nm (40 nm or more and less than 80 nm); and a region of equal to or greater than 80 nm and equal to or less than 120 nm (80 to 120 nm), in the entire particles having particles sizes of equal to or greater than 5 nm and equal to or less than 120 nm were calculated. Similarly, the ratios (% based volume) of the three regions of a region having particle sizes of equal to or greater than 10 nm and equal to or less than 30 nm; a region having particle sizes of equal to or greater than 45 nm and equal to or less than 75 nm; and a region having particle sizes of equal to or greater than 90 nm and equal to or less than 110 nm were also calculated.

[0020]

The method for adjusting the particle size distribution of the silica particles is not particularly limited. For instance, in the case where the silica particles are colloidal silica, the adjustment of the particle size distribution can be achieved by a method of giving the particle size distribution in a final product by adding the particles which can serve as a new core during the process of particle growth in the preparation steps, or the method including the step of mixing two or more silica particles that have different particle size distributions, or the like.

[0021]

In addition, as the abrasive, the abrasives that are generally used for polishing can be used in addition to the above-mentioned silica particles. The abrasive includes metals; carbides, nitrides, oxides and borides of metals or metalloids; diamond, and the like. The elements for metals or metalloids include those elements belonging to the Group 2A, 2B, 3A, 3B, 4A, 4B, 5A, 6A, 7A or 8A of the Periodic Table (long period form). Concrete examples of the abrasives include aluminum oxide, silicon carbide, diamond, magnesium oxide, zinc oxide, titanium oxide, cerium oxide, zirconium oxide and the like. It is preferable to use one or more kinds of these abrasives from the viewpoint of increasing the polishing rate. Among them, aluminum oxide, cerium oxide, zirconium oxide and titanium oxide are suitable for polishing a substrate for precision parts, such as substrates for magnetic recording media. As to aluminum oxide, various crystal systems such as  $\alpha$ ,  $\theta$  and  $\gamma$  are known, and they can properly be used and selected according to the intended purpose as occasion demands.

[0022]

The average primary particle size of the abrasive other than the silica particles is 200 nm or less. The average primary particle size is preferably 1 nm or more, more preferably 10 nm or more, even more preferably 20 nm or more, from the viewpoint of increasing the polishing rate, and the average primary particle size is 200 nm or less, preferably 150 nm or less, more preferably 120 nm or less, especially preferably 100 nm or less, from the viewpoint of reducing the surface roughness ( $R_a$ ,  $R_{max}$ ) and the waviness ( $W_a$ ). The average primary particle size is preferably from 1 to 200 nm, more preferably from 1 to 150 nm, even more preferably from 10 to 120 nm, especially preferably from 20 to

100 nm. Further, when the primary particles are aggregated to form a secondary particle, the average secondary particle size is preferably from 50 to 3000 nm, even more preferably from 100 to 1500 nm, especially preferably from 200 to 1200 nm, again, from the viewpoint of increasing the polishing rate and from the viewpoint of reducing the surface roughness of an object to be polished.

[0023]

The average primary particle size of the abrasive other than the silica particles can be obtained by analyzing the images observed with a scanning electron microscope (magnification: preferably from 3000 to 100000 times), and determining a particle size at 50% counted from a smaller particle size side of the primary particles in a cumulative particle size distribution on a number base (D50). Here, one primary particle size is defined as an arithmetic means of major axis length and minor axis length of the particle. In addition, the average secondary particle size can be determined as a volume-average particle size by using a laser beam diffraction method.

[0024]

The content of the abrasive containing silica particles is preferably 0.5% by weight or more, more preferably 1% by weight or more, even more preferably 3% by weight or more, especially preferably 5% by weight or more, of the polishing composition, from the viewpoint of increasing the polishing rate, and the content is preferably 20% by weight or less, more preferably 15% by weight or less, even more preferably 13% by weight or less, especially preferably 10% by weight or less, of the polishing composition, from the viewpoint of improving the surface quality and from the viewpoint of having economic advantages. Accordingly, the content is preferably from 0.5 to 20% by weight, more

preferably from 1 to 15% by weight, even more preferably from 3 to 13% by weight, especially preferably from 5 to 10% by weight, of the polishing composition.

[0025]

In addition, the polishing composition of the present invention may contain an oxidizing agent from the viewpoint of further increasing the polishing rate. The oxidizing agent includes peroxides, permanganic acid or salts thereof, chromic acid or salts thereof, peroxy acid or salts thereof, oxyacid or salts thereof, metal salts, sulfuric acid, and the like.

[0026]

The above-mentioned peroxide includes hydrogen peroxide, sodium peroxide, barium peroxide, and the like; the permanganic acid or salts thereof include potassium permanganate, and the like; the chromic acid or salts thereof include metal salts of chromic acid, metal salts of dichromic acid, and the like; the peroxy acid or salts thereof include peroxodisulfuric acid, ammonium peroxodisulfate, metal salts of peroxodisulfuric acid, peroxophosphoric acid, peroxosulfuric acid, sodium peroxoborate, performic acid, peracetic acid, perbenzoic acid, perphthalic acid, and the like; oxyacid or salts thereof include hypochlorous acid, hypobromous acid, hypoiodous acid, chloric acid, bromic acid, iodic acid, sodium hypochlorate, calcium hypochlorate, and the like; metal salts include iron (III) chloride, iron (III) sulfate, iron (III) citrate, ammonium iron (III) sulfate, and the like. Preferred oxidizing agents include hydrogen peroxide, iron (III) nitrate, peracetic acid, ammonium peroxodisulfate, iron (III) sulfate, ammonium iron (III) sulfate and the like. Especially, hydrogen peroxide is preferable, from the viewpoints of being widely used and inexpensive

without depositing metal ions to the surface. These oxidizing agents can be used alone or in admixture of two or more kinds.

[0027]

The content of the oxidizing agent is preferably 0.002% by weight or more, more preferably 0.005% by weight or more, even more preferably 0.007% by weight or more, especially preferably 0.01% by weight or more, of the polishing composition, from the viewpoint of increasing the polishing rate. Also, the content is preferably 20% by weight or less, more preferably 15% by weight or less, even more preferably 10% by weight or less, especially preferably 5% by weight or less, of the polishing composition, from the viewpoints of reducing the surface roughness and the waviness, and reducing the surface defects such as pits and scratches, thereby improving the surface quality, and from the viewpoint of economic advantages. The content is preferably from 0.002 to 20% by weight, more preferably from 0.005 to 15% by weight, even more preferably from 0.007 to 10% by weight, especially preferably from 0.01 to 5% by weight, of the polishing composition.

[0028]

Also, the polishing composition of the present invention may contain an acid and/or a salt thereof. As the acid and/or salt thereof, those compounds of which acidic form has pK<sub>1</sub> of 2 or less are preferable. The pK<sub>1</sub> is 1.5 or less, more preferably 1 or less, and most preferably those having such strong acidity which cannot be expressed by pK<sub>1</sub> are desirable, from the viewpoint of reducing fine scratches. Examples thereof include an inorganic acid, such as nitric acid, sulfuric acid, sulfurous acid, persulfuric acid, hydrochloric acid, perchloric acid, phosphoric acid, phosphonic acid, phosphinic acid, pyrophosphoric acid,

tripolyphosphoric acid, or amide sulfuric acid, and a salt thereof; organic phosphonic acid, such as 2-aminoethylphosphonic acid, 1-hydroxyethylidene-1,1-diphosphonic acid, aminotri(methylenephosphonic acid), ethylenediaminetetra(methylenephosphonic acid), diethylenetriaminepenta(methylenephosphonic acid), ethane-1,1,-diphosphonic acid, ethane-1,1,2-triphosphonic acid, ethane-1-hydroxy-1,1-diphosphonic acid, ethane-1-hydroxy-1,1,2-triphosphonic acid, ethane-1,2-dicarboxy-1,2-diphosphonic acid, methanehydroxyphosphonic acid, 2-phosphonobutane-1,2-dicarboxylic acid, 1-phosphonobutane-2,3,4-tricarboxylic acid, or  $\alpha$ -methylphosphonosuccinic acid, and a salt thereof; an aminocarboxylic acid, such as glutamic acid, picolinic acid, or aspartic acid, and a salt thereof; a carboxylic acid, such as oxalic acid, nitroacetic acid, maleic acid, or oxaloacetic acid, and a salt thereof; and the like. Among them, the inorganic acids, the organic phosphonic acids, and salts thereof are preferable, from the viewpoint of reducing the fine scratches. Among the inorganic acid and a salt thereof, nitric acid, sulfuric acid, hydrochloric acid, perchloric acid and salts thereof are more preferable. Among the organic phosphonic acid and a salt thereof, 1-hydroxyethylidene-1,1-diphosphonic acid, aminotri(methylenephosphonic acid), ethylenediaminetetra(methylenephosphonic acid), diethylenetriaminepenta(methylenephosphonic acid), and salts thereof are more preferable. These acids and salts thereof can be used alone or in admixture of two or more kinds. Here, pK1 is defined as follows: A logarithmic value of an inverse of an acid dissociation constant (25°C) of an organic compound or an

inorganic compound is usually expressed as  $pK_a$ , and a logarithmic value of an inverse of a first acid dissociation constant is defined as  $pK_1$ . The  $pK_1$  of each compound is listed in, for instance, in *Kagaku Binran (Kiso-hen)* II, Fourth Revision, pp. 316-325 (Edit. by Nippon Kagakukai), and the like. In the present invention, it is especially preferable to use those acids having  $pK_1$  of 2 or less and/or a salt thereof, from the viewpoint of satisfying both reduction of fine scratches and the polishing rate.

[0029]

The salts of these acids are not particularly limited. Concrete examples thereof include salts with a metal, ammonium, an alkylammonium, an organic amine or the like. Concrete examples of the metals include those metals belonging to the Group 1A, 1B, 2A, 2B, 3A, 3B, 4A, 6A, 7A or 8 of the Periodic Table (long period form). Among them, the salt with the metal belonging to Group 1A or with ammonium is preferable, from the viewpoint of reducing the fine scratches.

[0030]

The content of the above-mentioned acid and the salt thereof is preferably from 0.0001 to 5% by weight, more preferably from 0.0003 to 3% by weight, even more preferably from 0.001 to 2% by weight, especially preferably from 0.0025 to 1% by weight, of the polishing composition, from the viewpoint of exhibiting sufficient polishing rate and from the viewpoint of improving the surface quality.

[0031]

Water in the polishing composition of the present invention is used as a medium. For instance, distilled water, ion exchanged water or ultrapure water

is used. From the viewpoint of efficiently polishing the object to be polished, the water content is preferably 55% by weight or more, more preferably 67% by weight or more, even more preferably 75% by weight or more, especially preferably 84% by weight or more, of the polishing composition of the present invention, and the water content is preferably 99.4979% by weight or less, more preferably 98.9947% by weight or less, even more preferably 96.992% by weight or less, especially preferably 94.9875% by weight or less, of the polishing composition of the present invention. The water content is preferably from 55 to 99.4979% by weight, more preferably from 67 to 98.9947% by weight, even more preferably from 75 to 96.992% by weight, especially preferably from 84 to 94.9875% by weight of the polishing composition of the present invention.

[0032]

The concentration of each component of the above-mentioned polishing composition may be any of the concentration during the preparation of the composition and the concentration upon use. In many cases, the polishing composition is usually prepared as a concentrate, which is diluted upon use.

[0033]

In addition, there can be added other components to the polishing composition of the present invention as occasion demands. The other components include thickeners, dispersing agents, anticorrosive agents, basic substances, surfactants, and the like.

[0034]

The polishing composition of the present invention can be prepared by mixing the above-mentioned abrasive, an oxidizing agent, an acid and/or a salt thereof, water and, as occasion demands, other components by a known method.

[0035]

It is preferable that the pH of the polishing composition of the present invention is appropriately determined depending upon the kinds of the objects to be processed and the properties to be needed. Although the pH of the polishing composition of the present invention cannot be absolutely determined because it differs depending upon the materials of the objects to be polished, it is desirable that the pH generally is acidic, preferably less than 7, more preferably 6 or less, even more preferably 5 or less, especially preferably 4 or less, from the viewpoint of increasing the polishing rate in metal materials. In addition, the pH is preferably 1 or more, more preferably 1.1 or more, even more preferably 1.2 or more, especially preferably 1.3 or more, from the viewpoints of influence to a human body and corrosivity of the machine. Especially in the substrate for precision parts mainly made of a metal such as an aluminum alloy substrate plated with nickel-phosphorus (Ni-P), it is preferable that the pH is acidic from the viewpoint of the polishing rate, and that the pH is preferably 4.5 or less, more preferably 4 or less, even more preferably 3.5 or less, especially preferably 3 or less, from the viewpoint of increasing the polishing rate. Therefore, although the pH may be set in accordance with the purpose which is to be considered important, especially in the substrate for precision parts mainly made of a metal such as an aluminum alloy substrate plated with Ni-P, the pH is preferably from 1 to 4.5, more preferably from 1.1 to 4, even more preferably from 1.2 to 3.5, especially preferably from 1.3 to 3, from the total viewpoints mentioned above. The pH can be adjusted by properly adding an inorganic acid such as nitric acid or sulfuric acid, an organic acid such as oxalic acid, an ammonium salt, a basic substance such as an aqueous ammonia, potassium hydroxide, sodium hydroxide

or an amine in a desired amount.

[0036]

The method of reducing micropits of the present invention includes a method using the polishing composition of the present invention to a substrate to be polished when polishing. The polishing process for a substrate to be polished includes a polishing process including the step of polishing a substrate to be polished with the polishing composition of the present invention, or polishing a substrate to be polished with the polishing composition prepared by mixing each component so as to have the same composition as the polishing composition of the present invention and, in particular, a substrate for precision parts, such as a substrate for memory hard disk, can be suitably manufactured. In addition, the polishing composition of the present invention can exhibit a high polishing rate, with remarkably reducing micropits.

[0037]

The material for an object to be polished with the polishing composition of the present invention includes, for instance, metals or metalloids such as silicon, aluminum, nickel, tungsten, copper, tantalum and titanium, and alloys thereof; glassy substances such as glass, glassy carbon and amorphous carbons; ceramic materials such as alumina, silicon dioxide, silicon nitride, tantalum nitride, and titanium carbide; resins such as polyimide resins; and the like. Among them, an object to be polished is preferably made of a metal such as aluminum, nickel, tungsten or copper, or made of an alloy containing these metals as the main components, for instance, an aluminum alloy substrate plated with Ni-P is more preferable, and the aluminum alloy substrate plated with Ni-P is especially preferable.

[0038]

The polishing process with the polishing composition of the present invention includes, for instance, a process including the step of setting a substrate with polishing platens to which a nonwoven polishing pad made of an organic polymer is attached; feeding a polishing composition to a polishing surface, and moving the polishing platens or the substrate with applying a given pressure. In the above-mentioned process, the generation of micropits can be markedly suppressed by using the polishing composition of the present invention. In other words, the above-mentioned polishing process is a method of reducing micropits of a substrate.

[0039]

The method for manufacturing a substrate of the present invention includes a polishing step using the above-mentioned polishing composition. The polishing step is preferably carried out in the second step or subsequent steps among the plural polishing steps, and especially preferably in the final polishing step. For instance, a substrate for magnetic disk with a very small number of generation of micropits can be manufactured in a polishing step using the polishing composition of the present invention by polishing an Ni-P plated aluminum alloy substrate having a surface roughness (Ra) of from 0.5 to 1.5 nm and a waviness (Wa) of from 0.5 to 1 nm obtained in the first polishing step or the second polishing step.

[0040]

The manufactured substrate has excellent surface smoothness in addition to the remarkable reduction in the micropits. As the surface smoothness, it is desired that the surface roughness (Ra) is 0.3 nm or less, preferably 0.25 nm or

less, and that the waviness (Wa) is 0.3 nm or less, preferably 0.25 nm or less.

[0041]

As described above, a high-quality substrate having an excellent surface properties, in which the generation of the micropits is remarkably reduced and the surface smoothness is improved, can be manufactured with high production efficiency by using the polishing composition of the present invention.

[0042]

The polishing composition of the present invention is especially effective in the polishing step, but it can be similarly applied to the other polishing steps, for instance, lapping process, and the like.

[0043]

[Examples]

(Object to Be Polished)

Polishing evaluation was carried out by using an Ni-P plated aluminum alloy substrate which was previously roughly polished with a polishing slurry containing alumina abrasives so that the substrate had a surface roughness (Ra) of 1 nm, a thickness of 1.27 mm, and a diameter of 95 mm as a substrate to be polished.

[0044]

#### Examples 1 to 4 and Comparative Examples 1 to 9

There were added together the silicas (Silicas A to G), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ), HEDP and balance water (ion-exchanged water) as listed in Table 1 with mixing, to give each of the polishing compositions having the composition as shown in Table 1. The order of adding is as follows: A 35% by weight hydrogen peroxide was added to an aqueous solution prepared by diluting

1-hydroxyethylidene-1,1-diphosphonic acid in water, thereafter other components were added thereto, and a colloidal silica slurry was finally added to the mixture obtained with stirring not to cause gelation, to give a polishing composition. Here, the particle size distribution of the silica particles contained in the abrasive of each of the resulting polishing compositions is shown in Table 2.

[0045]

[Table 1]

Ex. No.	Composition of Polishing Composition (% by weight)										pH
	Silica A	Silica B	Silica C	Silica D	Silica E	Silica F	Silica G	H <sub>2</sub> O <sub>2</sub>	HEDP		
Ex. 1	9.00	-	-	-	-	-	-	0.3	0.43	2.2	
Ex. 2	-	-	1.35	5.40	-	-	2.25	0.3	0.43	2.0	
Ex. 3	-	-	1.35	6.30	-	-	1.35	0.3	0.43	2.0	
Ex. 4	-	-	1.35	6.30	-	1.35	-	0.3	0.43	2.0	
<u>Comp. Ex. No.</u>											
Comp. Ex. 1	-	2.25	6.75	-	-	-	-	0.3	0.43	2.0	
Comp. Ex. 2	-	9.00	-	-	-	-	-	0.3	0.43	2.0	
Comp. Ex. 3	-	-	-	7.65	-	-	1.35	0.3	0.43	2.0	
Comp. Ex. 4	-	-	-	6.75	-	-	2.25	0.3	0.43	2.0	
Comp. Ex. 5	-	-	6.92	-	1.73	-	0.35	0.3	0.43	2.0	
Comp. Ex. 6	-	-	-	7.20	-	-	1.80	0.3	0.43	2.0	
Comp. Ex. 7	-	-	-	4.50	4.50	-	-	0.3	0.43	2.0	
Comp. Ex. 8	-	-	7.20	-	1.80	-	-	0.3	0.43	2.0	
Comp. Ex. 9	-	-	1.80	-	7.20	-	-	0.3	0.43	2.0	

[0046]

In Table 1,

HEDP is 1-Hydroxyethylidene-1,1-diphosphonic acid "Dequest 2010"

(commercially available from SOLUTIA JAPAN INC.);

H<sub>2</sub>O<sub>2</sub> is 35% by weight hydrogen peroxide (commercially available from ASAHI DENKA KOGYO K.K.);

Silica A is Syton 520 (commercially available from Du Pont K.K.);

Silica B is Silicadol 30G (commercially available from Nippon Chemical Industrial CO., LTD.);

Silica C is Cataloid SI-80P (commercially available from CATALYSTS & CHEMICALS INDUSTRIES CO., LTD.);

Silica D is Cataloid SI-45P (commercially available from CATALYSTS & CHEMICALS INDUSTRIES CO., LTD.);

Silica E is Cataloid SI-50 (commercially available from CATALYSTS & CHEMICALS INDUSTRIES CO., LTD.);

Silica F is Cataloid SI-40 (commercially available from CATALYSTS & CHEMICALS INDUSTRIES CO., LTD.); and

Silica G is Cataloid SI-30 (commercially available from CATALYSTS & CHEMICALS INDUSTRIES CO., LTD.).

[0047]

Next, a substrate to be polished was polished with each of the resulting polishing compositions as described as follows. The presence or absence of the micropits on the substrate was evaluated.

[0048]

[Polishing Conditions]

Polishing testing machine: “Double-Sided Processing Machine, Model 9B,” commercially available from SPEEDFAM CO., LTD.

Polishing pad: “Belatrix N0058” manufactured by Kanebo, LTD.

Rotational speed of platens: 32.5 r/min

Feeding amount for a slurry: 40 ml/min

Polishing time period: 4 minutes

Polishing pressure: 7.8 kPa

Number of substrates introduced: 10

[0049]

[Method for Determination of Micropits]

Front and back sides of 5 substrates were observed with a differential interference microscopic system [metal microscope “BX60M” (commercially available from OLYMPUS OPTICAL Co., Ltd.), magnification: 50 times (eyepiece: 10 times, objective lens: 5 times)], and the number of micropits were counted, with scanning along line segments AB, CD, EF, GH as shown in Figure 1.

The results are shown in Table 2 in accordance with the following evaluation criteria.

[0050]

Evaluation Criteria

“◎”: less than 0.3 micropits/side;

“○”: 0.3 or more and less than 1 micropit/side;

“△”: 1 or more and less than 5 micropits/side;

“×”: 5 or more and less than 20 micropits/side;

“××”: 20 or more and less than 100 micropits/side; and

“xxx”: 100 or more micropits/side.

[0051]

[Table 2]

Ex. No.	Amount of Particles of 5-120 nm in Entire Silica Particles*)	Particles of 5 nm or more and less than 40 nm	Particles of 40 nm or more and less than 80 nm	Particles of 80-120 nm	Particles of 10-30 nm	Particles of 45-75 nm	Particles of 90-110 nm	Micropits
Ex. 1	69.4	32.0	41.5	26.5	12.3	30.5	13.2	◎
Ex. 2	99.9	26.8	58.6	14.6	25.7	54.4	13.0	○
Ex. 3	99.9	16.8	69.0	14.2	15.6	64.0	12.7	○
Ex. 4	99.9	16.1	69.4	14.5	14.9	64.5	12.9	○
<u>Comp. Ex. No.</u>								
Comp. Ex. 1	99.9	0.0	20.9	79.1	0.0	16.5	66.6	xxx
Comp. Ex. 2	100.0	0.1	79.6	20.4	0.0	62.9	3.6	x
Comp. Ex. 3	100.0	16.9	83.1	0.0	15.5	77.1	0.0	x
Comp. Ex. 4	100.0	27.0	73.0	0.0	25.7	67.8	0.0	x
Comp. Ex. 5	99.9	23.3	0.4	76.3	7.2	0.0	68.0	x
Comp. Ex. 6	100.0	22.0	78.0	0.0	20.6	72.4	0.0	x
Comp. Ex. 7	100.0	49.5	50.5	0.0	7.7	46.1	0.0	x
Comp. Ex. 8	99.9	20.0	0.4	79.6	3.2	0.0	70.9	xx
Comp. Ex. 9	99.9	79.0	1.4	19.6	12.5	0.0	17.5	x

Note \*): The percentage of the amount in the table is expressed as % by volume.

[0052]

It can be seen from the results in Table 2 that all of the polishing compositions obtained in Examples 1 to 4 exhibit remarkably excellent effect of reducing the micropits as compared to those of the polishing compositions obtained in Comparative Examples 1 to 9.

[0053]

[Effects of the Invention]

By using the polishing composition of the present invention, there is exhibited an effect that a substrate for precision parts, such as a substrate for memory hard disk, in which micropits are remarkably reduced, can be economically advantageously manufactured.

[Brief Description of the Drawings]

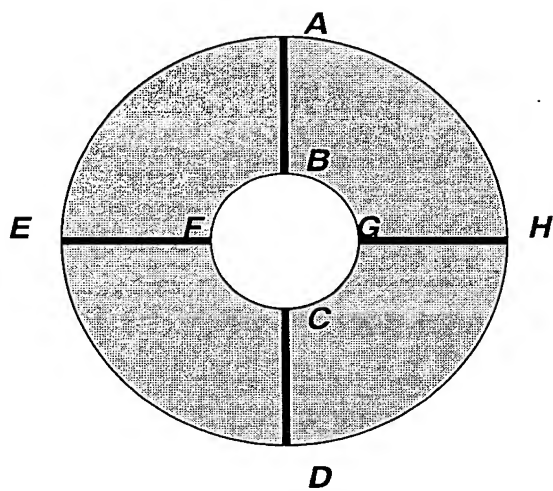
[Figure 1]

Figure 1 is a schematic view showing the sites on the substrate scanned by a differential interference microscope in the determination of micropits.

[Document]

Drawings

[Figure 1]



[Document]      Abstract

[Abstract]

[Problems]

To provide a polishing composition for polishing a substrate for memory hard disk, with which micropits of the object to be polished after polishing are remarkably reduced and the polishing can be carried out economically advantageously, a method of reducing micropits with the polishing composition, and a method for manufacturing a substrate with the above-mentioned polishing composition.

[Solving Means]

A polishing composition for a memory hard disk comprising an abrasive in an aqueous medium, wherein the abrasive comprises silica particles having particle sizes of from 5 to 120 nm in an amount of 50% by volume or more, wherein the abrasive comprises 10 to 70% by volume of small size silica particles having particle sizes of 5 nm or more and less than 40 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; 20 to 70% by volume of intermediate size silica particles having particle sizes of 40 nm or more and less than 80 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; and 0.1 to 40% by volume of large size silica particles having particle sizes of 80 nm to 120 nm based on an entire amount of the silica particles having particle sizes of from 5 to 120 nm; a method of reducing micropits with the above-mentioned polishing composition; and A method for manufacturing an Ni-P plated substrate for memory hard disk with the above-mentioned polishing composition.

[Selected Drawings]      None

## BACKGROUND INFORMATION OF APPLICANT

Identification Number [000000918]

1. Date of Conversion August 24, 1990

[Reason for Conversion] New Registration

Address 14-10, 1-chome, Kayaba-cho, Nihonbashi,  
Chuo-ku, Tokyo

Name Kao Corporation

2. Date of Conversion April 18, 2003

[Reason for Conversion] Change of Name

Change of Address

Address 14-10, 1-chome, Kayaba-cho, Nihonbashi,  
Chuo-ku, Tokyo

Name Kao Corporation